

WHAT IS CLAIMED IS:

1 1. A suture fastener for adjustably holding one or more suture strands
2 comprising:
3 at least one fastening element comprised of a shape-recovery material,
4 wherein the element has a tensioned position for engaging the suture strands while allowing
5 sliding of the element relative to the suture strands and a relaxed shape-recovery position for
6 holding the strands in a fixed position relative to the element or to each other.

1 2. A suture fastener as in claim 1, wherein the element holds the suture
2 strands along a tortuous path in the relaxed shape-recovery position.

1 3. A suture fastener as in claim 2, wherein the suture strands comprise a
2 first suture strand and a second suture strand, wherein the first strand follows a first tortuous
3 path and the second strand follows a second tortuous path which differs from the first
4 tortuous path.

1 4. A suture fastener as in claim 2, wherein the tortuous path has a zig zag
2 form or spiral form.

1 5. A suture fastener as in claim 1, wherein the element holds the suture
2 strands along a substantially straight path in the tensioned position.

1 6. A suture fastener as in claim 1, wherein the element comprises a coil.

1 7. A suture fastener as in claim 6, wherein at least one turn of the coil has
2 a circular, triangular, square or multi-sided shape.

1 8. A suture fastener as in claim 6, wherein at least one turn of the coil
2 includes at least one suture retention loop.

1 9. A suture fastener as in claim 8, wherein each suture retention loop has
2 a circular, oval, elliptical, square, triangular or multi-sided shape.

1 10. A suture fastener as in claim 8, wherein the suture retention loops of
2 each coil turn are disposed in diametrical opposition when the element has the relaxed shape-
3 recovery position.

11. A suture fastener as in claim 10, wherein the each turn of the coil has a circular shape when the element has the relaxed shape-recovery position.

12. A suture fastener as in claim 10, wherein each turn of the coil has an elliptical shape when the element has the relaxed shape-recovery position and the suture retention loops of each coil turn are disposed along a long axis of the elliptical shape.

13. A suture fastener as in claim 10, wherein each turn of the coil has a figure-eight shape comprising two lobes when the element has the relaxed shape-recovery position and one suture retention loop is disposed within each lobe.

14. A suture fastener as in claim 8, wherein the suture retention loops are disposed in substantially concentric alignment when the element has the tensioned position.

15. A suture fastener as in claim 1, wherein the element has a flat shape when in the tensioned position and the element has a curved or bent shape in the relaxed shape-recovery position.

16. A suture fastener as in claim 15, wherein the element comprises an elongate wire, ribbon, rod, filament or shaft.

17. A suture fastener as in claim 16, wherein the element has two or more apertures along its length.

18. A suture fastener as in claim 17, wherein the element comprises a ribbon the has a width in the range of approximately 0.030 to 0.120 inches and a thickness in the range of approximately 0.002 to 0.020 inches.

19. A suture fastener as in claim 16, wherein two or more elements interlock when the elements are in the relaxed shape-recovery position.

20. A suture fastener as in claim 1, wherein the element has a first portion having at least one first aperture and a second portion having at least one second aperture, wherein at least one first aperture is concentrically aligned with at least one second aperture when the element is in the tensioned position and the at least one first aperture is misaligned with the at least one second aperture when the element is in the relaxed shape-recovery position.

1 21. A suture fastener as in claim 20, wherein at least part of the first
2 portion overlaps at least part of the second portion when the element is in the tensioned
3 position.

1 22. A suture fastener as in claim 21, wherein the element has a cylindrical,
2 triangular, square, oblong or irregular shape.

1 23. A suture fastener as in claim 1, wherein the element is transitionable
2 from the tensioned position to the relaxed position by release of a force on the element.

1 24. A suture fastener as in claim 1, wherein the element is transitionable
2 from the tensioned position to the relaxed position by a change in temperature of the element.

1 25. A method for securing two or more suture strands together, comprising
2 the steps of:

3 providing at least one fastening element comprised of a shape-recovery
4 material, wherein the element is in a tensioned position for engaging the suture strands while
5 allowing sliding of the element relative to the suture strands;

6 engaging the suture strands with the element; and

7 transitioning the element to a relaxed shape-recovery position wherein the
8 strands are in a fixed position relative to the element or to each other.

1 26. A method as in claim 25, wherein the engaging step comprises
2 positioning the suture strands along a path through at least a portion of the element.

1 27. A method as in claim 26, wherein the engaging step comprises
2 positioning a first suture strand along a first path and a second suture strand along a second
3 path which differs from the first path.

1 28. A method as in claim 26, wherein the element comprises a coil where
2 each turn of the coil includes two or more suture retention loops and the positioning step
3 includes positioning the suture strands through two or more suture retention loops.

1 29. A method as in claim 28, wherein the suture retention loops of each
2 coil turn are disposed in diametrical opposition when the element is in the relaxed shape-
3 recovery position, and the positioning step includes positioning the suture strands through

4 successive suture retention loops so that the strands follow a tortuous path when the element
5 is in the relaxed shape-recovery position.

1 30. A method as in claim 25, wherein the providing step comprises loading
2 the element on a loading tool.

1 31. A method as in claim 25, wherein the providing step comprises
2 providing the element loaded on or within a loading tool.

1 32. A method as in claim 30 or 31, wherein the transitioning step
2 comprises releasing the element from the loading tool.

1 33. A method as in claim 26, wherein the element comprises an elongate
2 wire, ribbon, rod, filament, shaft, mesh or woven sheet having two or more apertures along its
3 length and the positioning step comprises positioning the suture strands through at least two
4 apertures.

1 34. A method as in claim 33, wherein the positioning step comprises
2 positioning the suture strands through apertures in a stitching fashion.

1 35. A method as in claim 25, wherein the element comprises an elongate
2 wire, ribbon, rod, filament or shaft and the engaging step comprises positioning the suture
3 strands near at least two elements so that the elements capture the suture strands during the
4 transitioning step by interlocking with each other.

1 36. A method as in claim 26, wherein the element has a first portion
2 having at least one first aperture and a second portion having at least one second aperture and
3 the positioning step comprises positioning the suture strands through at least one first
4 aperture and at least one second aperture.

1 37. A method as in claim 36, wherein the providing step includes
2 providing the element so that at least one first aperture is concentrically aligned with at least
3 one second aperture and the positioning step comprises positioning the suture strands through
4 apertures in a stitching fashion.

1 38. A method as in claim 25, further comprising sliding the element along
2 the suture strands to a desired position prior to the transitioning step.

1 39. A method as in claim 25, further comprising adjusting the position of
2 the element along the suture strands after the transitioning step.

1 40. A method as in claim 39, wherein the adjusting step comprises:
2 transitioning the element to the tensioned position; and
3 moving the element in relation to the suture strands.

1 41. A system for adjustably holding one or more suture strands
2 comprising:
3 at least one fastening element comprised of a shape-recovery material,
4 wherein the element has a tensioned position for engaging the suture strands while allowing
5 sliding of the element relative to the suture strands and a relaxed shape-recovery position for
6 holding the strands in a fixed position relative to the element or to each other; and
7 a loading tool having a proximal end, a distal end and a lumen therethrough,
8 wherein the element is loadable on the loading tool.

1 42. A system as in claim 41, wherein the loading tool further comprises a
2 shaft near the distal end.

1 43. A system as in claim 42, wherein the element comprises a coil which is
2 mountable on the shaft.

1 44. A system as in claim 43, wherein each turn of the coil includes at least
2 one suture retention loop and wherein the coil is loadable on the loading tool by inserting the
3 shaft through at least one of the suture retention loops.

1 45. A system as in claim 41, further comprising at least one suture strand
2 which is engageable by the element.

1 46. A system as in claim 45, wherein the loading tool further comprises a
2 shaft near the distal end which houses at least a portion of the lumen through which the suture
3 strand is threadable.

1 47. A suture fastening system for adjustably holding one or more suture
2 strands comprising:

3 a delivery catheter comprising a proximal end, a distal end, and a lumen
4 therethrough; and

5 a suture fastener loadable on the distal end of the delivery catheter, said
6 fastener comprising a ratcheting mechanism which is adapted to hold a suture strand at a first
7 location and then release the strand and hold the strand at a second location upon adjustment,
8 wherein the first and second locations are a predetermined distance apart.

1 48. A suture fastening system as in claim 47, further comprising at least
2 one suture strand, wherein the strand has at least a first protuberance disposed near the first
3 location and a second protuberance disposed near the second location.

1 49. A suture fastening system as in claim 48, wherein the suture strand
2 comprises a fiber, thread, filament, wire, cord, strand, cable or rope.

1 50. A suture fastening system as in claim 49, wherein at least one
2 protuberance is selected from the group consisting of knots, beads, balls, ribs, and spokes.

1 51. A suture fastening system as in claim 48, wherein the suture strand or
2 at least one protuberance is comprised of a material selected from the group consisting of
3 stainless steel, metal, polymer, silicone, latex, epoxy, cotton, nylon, polyester, and Teflon.

1 52. A suture fastening system as in claim 48, wherein the ratcheting
2 mechanism comprises at least two flexible arms having stoppers mounted thereon which are
3 engageable with the protuberance.

1 53. A suture fastening system as in claim 47, wherein the suture fastener is
2 loadable within the lumen of the delivery catheter.

1 54. A method for adjustably holding a suture strand comprising the steps
2 of:

3 providing a delivery catheter comprising a proximal end, a distal end, and a
4 lumen therethrough;

5 loading a suture fastener on the distal end of the delivery catheter, said
6 fastener comprising a ratcheting mechanism which is adapted to hold the suture strand at a
7 first location and then hold the strand at a second location upon adjustment, wherein the first
8 and second locations are a predetermined distance apart; and

9 engaging the suture fastener with the suture strand at the first location.

1 55. A method as in claim 54, wherein the suture strand has at least a first
2 protuberance disposed near the first location, wherein the ratcheting mechanism comprises at
3 least two flexible arms each having a stopper mounted thereon which are engageable with the
4 first protuberance, and wherein the loading step comprises positioning the suture strand so
5 that the stopper engages the first protuberance.

1 56. A method as in claim 54, further comprising adjusting the suture strand
2 by advancing the strand through the fastener so that the fastener engages the strand at the
3 second location.

1 57. A method as in claim 56, wherein the suture strand has at least a
2 second protuberance disposed near the second location, wherein the ratcheting mechanism
3 comprises at least two flexible arms each having a stopper mounted thereon which are
4 engageable with the second protuberance, and wherein the loading step comprises advancing
5 the suture strand so that the stopper engages the second protuberance.

1 58. A kit for adjustably holding one or more suture strands comprising:
2 at least one fastening element comprised of a shape-recovery material,
3 wherein the element has a tensioned position for engaging the suture strands while allowing
4 sliding of the element relative to the suture strands and a relaxed shape-recovery position for
5 holding the strands in a fixed position relative to the element or to each other; and
6 instructions for use.

1 59. A kit as in claim 58, further comprising a loading tool.

1 60. A kit as in claim 58, further comprising the suture strands.

1 61. A kit for adjustably holding one or more suture strands comprising:
2 a suture fastener comprising a ratcheting mechanism which is adapted to hold
3 a suture strand at first location and then release the strand and hold the strand at a second
4 location upon adjustment, wherein the first and second locations are a predetermined distance
5 apart; and
6 instructions for use.

1 62. A kit as in claim 61, further comprising a delivery catheter comprising
2 a proximal end, a distal end, and a lumen therethrough.

1 63. A kit as in claim 61, further comprising the suture strands.

1 64. A kit as in claim 63, wherein each strand has at least a first
2 protuberance disposed near the first location and a second protuberance disposed near the
3 second location.

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